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ABSTRACT

Presented is a fitness profile designed to identify the individual athlete's strengths and weaknesses. Specifically, the areas of fitness examined are a) muscular strength; b) cardiovascular respiratory function; c) body composition; and d) motor abilities, agility, and speed. The procedures in the testing program involve the following: a) the establishment of a site for ski training and testing, b) fitness testing, c) appraisal of the fitness profile with each athlete, and d) a training prescription for improving weak areas. Detailed explanations of individual tests for the specific abilities listed above are provided. (JB)

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United States Ski Team Fitness Testing Program

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As part of the Sports Medicine Team approach to improve ski performance, fitness testing provides pertinent information concerning the training programs of each competitor. The main thrust of a fitness profile is to identify the individual athlete's strengths and weaknesses in the various aspects of fitness. Specifically, the areas of fitness examined are, (1) muscular strength, (2) cardiovascular-respiratory function, (3) body composition and (4), motor abilities; agility and speed, balance, flexibility, power, and response time. The procedures in the testing programs for the U.S. Alpine and Nordic ski teams involve the following: (1) establishment of site for ski training and testing, (2) fitness testing, (3) appraisal of fitness profile with each athlete, and (4) training prescription for improving weak areas. It is not the intent of the testing program to predict athletic success but to aid the individual athlete in his or her training program. It is considered desirable that the athlete is best prepared for world-class competition. Most of the fitness profiles collected to date consist of data from the U.S Alpine Ski Teams, U.S. Cross Country Ski Teams, U.S. Jumping Team, and national calibre junior skiers from both the alpine and nordic programs. The comparative results indicate that the U.S. Jumping team possesses the best strength, power and balance scores of the ski teams. Highest maximun oxygen intakes average 75.5 ml/kg·min for male XCC skiers and 62.5 ml/kg·min for female XCC skiers. Lowest percents of body fat are recorded for male XCC skiers (8.6%), jumpers (10.7%), and alpine racers (11.0%). Female XCC skiers average 19.6 and female alpine racers are probably too fat for being athletes (24.5%). Interestingly, XCC skiers and jumpers have the fastest response times to visual stimuli and the best decision making times. This is probably due to the fact that the XCC skier and jumper has to make more decisions during the performance than do skiers in the other events.

1. Muscular Strength
   - A. Knee Extension:
     1. Maximun isometric strength of the quadriceps muscle group measured by a cable tensiometer. The knee joint was kept at a 115 degree angle.
   - B. Elbow Extension
     1. Maximun isometric strength of the triceps muscle group measured by a cable tensiometer. The elbow joint was kept at a 40 degree angle.
   - C. Grip Strength
     1. Maximun tension of finger flexors measured by a hand tensiometer.

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II. Cardiovascular-Respiratory Function
   A. Maximum Treadmill Run
      1. Progressive increase in speed and grade until exhaustion. Maximal heart rate, vertical lift work, and distance run were examined. Maximal oxygen consumption was determined when equipment was available.
   B. Maximal Bicycle Ergometer Ride
      1. Progressive increase in workload at 60rpm until exhaustion. Maximal heart rate and power output were examined.
   C. Submaximal Bicycle Ergometer Ride
      1. Males cycled 50 rpm for 5 min at 1500 kgm/min. Steady state heart rate and recovery heart rates were examined.
      2. Females cycled 50 rpm for 5 min at 1200 kgm/min. Steady state heart rate and recovery heart rates were examined.
   D. One Minute Step Test
      1. Used for large numbers of athletes with limited testing time.
      2. Test consists of stepping on an 18-inch bench at a rate of 30 trips for one minute. Heart rate recovery was examined.

III. Body Composition
   A. Percent Body Fat Prediction
      1. Pascale's prediction for body density by skinfold techniques was used for males. The skinfold sites included chest, axilla, and triceps.
      2. Sloan's prediction for body density by skinfold techniques was used for females. The skinfold sites included iliac crest and triceps.
      3. Brozek and Keys formula for converting density to percent body fat was used for both males and females.
      4. A few male cross-country skiers were weighted underwater to assess body composition.
      5. Girth measurements were taken to relate size of muscle area and strength.

IV. Motor Abilities
   A. Agility and Speed
      1. Timed Illinois Agility Run
      2. Number of six count squat thrusts in 10 seconds.
   B. Balance
      1. Timed balanced position on a balanciometer for 30 seconds
   C. Flexibility
      1. Cureton's shoulder hyperextension, trunk hyperextension, and trunk hyperflexion tests.
   D. Power
      1. Vertical jump test expressed in inches and work done in ft. lbs.
      2. Margaria-Kalamen stair run expressed in milliseconds and power output in kgm/sec.
   E. Response time-Visual Stimulus
      1. Hand (thumb) respone time
      2. Leg response time
         a. left, forward, and right movements of legs to switch mats.

V. Results

A. Leg Strength Averages

1. Males:
   - Alpine, age 14-15 = 373 lbs
   - Alpine, age 16-17 = 451 lbs
   - Alpine, age 18-21 = 529 lbs
   - XCC = 492 lbs
   - Jumpers = 622 lbs

2. Females:
   - Alpine, age 14-15 = 398 lbs
   - Alpine, age 16-17 = 383 lbs
   - Alpine, age 18-21 = 440 lbs
   - XCC = 405 lbs

B. Cardiovascular-Respiratory Measures

1. Maximum Heart Rates

   a. Males: XCC = 192 b/min

   b. Females: XCC = 197 b/min

2. Maximum Oxygen Uptakes

   a. Males: XCC = 5.5 L/min
      = 75.5 ml/kg·min

   b. Females: XCC = 3.5 L/min
      = 62.5 ml/kg·min

C. Body Fat

1. Male: Alpine, age 14-15 = 10.1%
Alpine, age 16-17 = 10.8%
Alpine, age 18-21 = 11.2%
XCC = 8.6%
Jumpers = 10.7%

2. Females: Alpine, age 14-15 = 24.2%
Alpine, age 16-17 = 23.6%
Alpine, age 18-21 = 25.1%
XCC = 13.6%

D. Balance

1. Male: Alpine, age 14-15 = 20.4 secs
Alpine, age 16-17 = 21.3 secs
Alpine, age 18-21 = 21.5 secs
Jumpers = 22.6 secs

2. Female: Alpine, age 14-15 = 20.4 secs
Alpine, age 16-17 = 20.0 secs
Alpine, age 18-21 = 21.7 secs

E. Power

1. Vertical Jump (inches)

a. Male: Alpine, age 14-15 = 17.4 ins
Alpine, age 16-17 = 20.5 ins
Alpine, age 18-21 = 22.3 ins
XCC = 15.7 ins
Jumpers = 26.7 ins

b. Female: Alpine, age 14-15 = 17.7 ins
Alpine, age 16-17 = 16.8 ins
Alpine, age 18-21 = 16.7 ins
XCC = 14.1 ins

2. Vertical Jump Work (ft. lbs.)

a. Male: Alpine, age 14-15 = 187 ft. lbs.
Alpine, age 16-17 = 250 ft. lbs.
Alpine, age 18-21 = 303 ft. lbs.
XCC = 199 ft. lbs.
Jumpers = 383 ft. lbs.

b. Female: Alpine, age 14-15 = 175 ft. lbs.
Alpine, age 16-17 = 174 ft. lbs.
Alpine, age 18- 21 = 188 ft.lbs.

3. M-K Stair Run (kgm/sec)

a. Male: Alpine, age 14-15 = 108 kgm/sec
Alpine, age 16-17 = 123 kgm/sec
Alpine, age 18-21 = 145 kgm/sec
XCC = 150 kgm/sec
Jumpers = 164 kgm/sec

b. Female: Alpine, age 14-15 = 86 kgm/sec
Alpine, age 16-17 = 88 kgm/sec
Alpine, age 18-21 = 91 kgm/sec
XCC = 115 kgm/sec

F. Response Time -- Leg

1. Male: Alpine, age 14-15 = .395 sec
Alpine, age 16-17 = .386 sec
Alpine, age 18-21 = .375 sec
XCC = .380 sec
Jumpers = .364 sec

2. Female: Alpine, age 14-15 = .402 sec
Alpine, age 16-17 = .414 sec
Alpine, age 18-21 = .406 sec
XCC = .390 sec